GEOSPATIAL CANCER ANALYSIS FOR THE STATE OF SANTA CATARINA, BRAZIL - ENVIRONMENTAL PARAMETERS CONSIDERED

Cleice Edinara Hübner¹ and Francisco Henrique Oliveira²,
¹State University of Santa Catarina - UDESC844, João Pio Duarte Silva Str. - Ap. 402 - Córrego Grande – Florianópolis – SC - Brazil – 88.037-000, hcleice@hotmail.com, (55 48) 234-3762/212-5304
²Geoprocessing Laboratory in the State University of Santa Catarina – UDESC, 265, Deodoro St. – Manoel Maia Bldg. – 3rd. floor – room 43 – Centre – Florianópolis – SC – Brazil – 88.010-020, chicoliver@yahoo.com.br, (55 48) 212-5301/212-5304

Abstract

Medical Geography results from the interconnection of medical and geographic knowledge in the study of the impact of the geographical environment on disease outbreak and spreading. With the help of the Geographic Information Systems (GIS), Medical Geography is extremely useful for decision taking in epidemiological surveillance programs. The history of GIS has started in 1854 when, in London, John Snow identified the cholera transmitter and the sites of occurrence with the resources of geoprocessing. This project considers the application of a GIS system to medical geography through the generation of a data bank of cancer occurrences in the State of Santa Catarina – Brazil, as documented by the Charity Hospital of Florianópolis-SC. After raising the data, GIS software available tools were used to evaluate the correlation between cancer occurrences and potential environmental factors, thematic maps being drawn to illustrate the correlations. According to epidemiological studies, the physical environment (water, earth and air), the occupational environment (chemical industries and alike), the consume environment (food and medicine) and the social and cultural environment (life styles and habits), all influence the manifestation of cancer (Rouquayrol, 1994). Fighting cancer as a public health problem requires, initially, knowledge about the occurrence of the disease and its variations in the different regions of Santa Catarina. Regional differences in the frequency of occurrence in different body parts, such as skin, esophagus, lungs, stomach, breast, among others, will undoubtedly originate etiological hypotheses for further testing, once lack of knowledge of the causes will render prevention and monitoring more difficult.

INTRODUCTION

According Lemos and Lima (2002), “Medical Geography has as its end the study of the distribution and prevalence of diseases on the surface of the Earth, as well as of all the changes that may happen to them under the influence of the most varied geographical factors”. From this concept of Medical Geography, the decision was made to focus cancer as a theme, once it is likely that, according to De Paola (1985), environmental factors (social, economical, cultural, political and physical) are in its roots. With the increase of urbanization and industrialization, environmental and ecological relations have been disrupted and the environment has become unfavorable to men through the direct action of physical, chemical and biological agents. It is important to mention that man is submitted to a large number of carcinogenic substances which are eaten, inhaled, absorbed through the skin, or yet introduced in the body by the ingestion of medicines or by accidents.
(Rouquayrol, 1994); under these conditions, cancer may be pointed out as a public health problem.

The infinite number of variables involved in the measurement of the effects of socio-environmental unbalance in the health of individuals poses great methodological obstacles to the work. However, it is possible to identify the most vulnerable populations which, submitted to critical environmental conditions, suffer with the effects of such unbalance. It is important to retrieve the studies by Peiter and Tobar (1998), Andreoni et al. (2001) and Koifman (1997) which have correlated the differential spatial distribution of the material conditions of life in urban areas with the differential spatial distribution of mortality caused by diseases/morbimortality. From this perspective, it has been sought to highlight the potential of geographic analysis for environmental studies and for studies on the material conditions of life, taking into consideration the physical space as an important mediator of health-disease processes.

The main purpose of this project is to use the GIS to generate thematic maps that spatially correspond to the distribution of occurrences of cancer in the State of Santa Catarina, correlating these occurrences to socio-environmental factors. The importance of arranging specific information into distinct information levels and of associating these levels of information afterwards shows the reason why the Geographic Information Systems are so useful in spatial analysis, therefore of concern to the public health theme of this project and to Santa Catarina public health authorities. This way, the thematic maps generated by the GIS will help managers in their decisions. They will also be considered of importance in the disclosing of results to lay people.

METHODOLOGY

The State of Santa Catarina is located in the south of Brazil. It has a population of about 4,500,000 inhabitants. Its environmental problems are regionally distinct, as a result of the economical activities of each region. In the west, agricultural industries contaminate the soil and rivers with pesticides and wastes from pigsties. Metal-mechanic and textile industries degrade many natural resources in the north, while coal mining contaminates extensive areas of environmental preservation in the south.

This research purports to identify the areas in the State of Santa Catarina that are spatially critical as to documented cancer occurrences and their association to potentially polluting economical activities, as well as to potential socio-environmental problems which unevenly affect the State. To this end, the map issued by the Brazilian Institute of Geography and Statistics (IBGE) in 1997, in the scale 1:500,000 has been used. The municipality has been taken as the unit for analysis, and all the 293 municipalities of the State of Santa Catarina have entered the survey. It has been carried out with the geoprocessing software Geomedia Professional 5.1.

The research was started in August, 2003 and from then on only steps 1 and 2 have been accomplished; steps 3, 4, 5 and 6 rest to be accomplished.

1- Mapping the year 2000 and the inclusion in the data bank of 941 instances of cancer documented in the Charity Hospital of Florianópolis-SC, which assists patients from all over the State. At a first glance, the sample may not seem representative, but it is worth of notice the lack of hierarchically organized, formatted and updated information on
cancer occurrences in public health institutions of Santa Catarina. Cancer registers per population in Brazil are invariably based on data from big cities (Porto Alegre, Fortaleza, Belém, Goiania and Campinas). There are no cancer registers per State or region. Thus, considering the occurrences of cancer in the State of Santa Catarina, and associating these occurrences to the resources of the GIS, and admitting environmental parameters to generate thematic maps which identify potential occurrence areas, this research project stands as an innovative and unique project in the public health management process;

2- Organization of cancer occurrences per municipality with the GIS, as well as their quantification and analysis, taking into account the population profile of each region. The prevalence of cancer types generated the thematic maps;

3- Mapping and classification of municipalities per level of life physical conditions – data from the Demographic Census of 2000 of the Brazilian Institute of Geography and Statistics (IBGE); such classification was taken as an approximate to the real situation of basic sanitation infrastructure of municipalities, their housing conditions, school level, family revenue, among other factors;

4- Mapping and classification of municipalities per potentially pollutant economic activities, or industries that use carcinogenic substances in their production process, using data from IBGE as a source of reference. On the other hand, the characterization of carcinogenic substances defined in this study is based on the International Agency for Research on Cancer (IARC) classification;

5- The spatial analysis by superposition of thematic maps will be carried out in two distinct steps. The first will tackle the generation of an intermediary thematic map, of concern to the research. In this map, data concerning cancer occurrence density in each municipality will be compared to data on the thematic map of life physical conditions. The result of this comparison will again be matched with information from the map of potentially pollutant economic activities;

6- From the final thematic map generated from the comparisons in step 5, the critical areas of each municipality will be spatially identified as to cancer type tendency.

PRELIMINARY RESULTS

The data bank of each patient contains detailed information about sex, age, occupation, place of origin, school level, treatments and exams made, present situation of the disease, smoking habits and alcoholism, among other relevant information. From these pieces of information, the quality and efficiency of the assistance given to cancer patients who use the Charity Hospital oncology service may be evaluated. Furthermore, a set of information may be passed onto the hospital staff concerning the characteristics of patients, the resources used in diagnosis and treatment, the evaluation of the disease evolution as well as the patient life quality. Because of this, the project stands as an invaluable tool for the Hospital to generate reports.

Table 1 shows the results of a survey from the data on patients with cancer in the esophagus. The system was asked to retrieve all the smokers and alcoholics with cancer in the esophagus whose occupation was farming. The results of this survey may also be seen on the map. Graphics and tables help the hospital community in their need of quick search for information.
Table 1: Result of query: Smokers and alcoholics with cancer of the esophagus whose occupation is farming.

<table>
<thead>
<tr>
<th>Nº of Hospital document</th>
<th>Occupation</th>
<th>Alcoholism</th>
<th>Tobacco</th>
</tr>
</thead>
<tbody>
<tr>
<td>91134</td>
<td>Farmer</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>89016</td>
<td>Farmer</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>96465</td>
<td>Farmer</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>97428</td>
<td>Farmer</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>96963</td>
<td>Farmer</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>103328</td>
<td>Farmer</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>102473</td>
<td>Farmer</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

The occurrences of different types of cancer in the State of Santa Catarina have been quantified per municipality and organized in thematic maps. Figure 1 shows the distribution of lung cancer in the State. 30 municipalities (light pink) have 1 to 5 cases, 2, Tubarão and Criciúma (light purple), present 5 to 10 cases, and 1, Florianópolis (orange), 25 to 31 cases. Municipalities in yellow show no occurrence of cancer at all. However, the fact that the Charity Hospital is in Florianópolis, the capital of the State, with a population of 340,000 inhabitants, may account for the larger number of patients. Tubarão and Criciúma are in the south of the State, a region of intense coal mining activity, resulting in great socio-environmental impact. This information, added to the data on life conditions of the population, is relevant to the raising of etiological hypotheses for further testing.

![Map of lung cancer distribution per municipality of Santa Catarina/Brazil.](image)

**EXPECTED RESULTS**

Besides spatial identification of critical areas (municipalities) in the State of Santa Catarina by cancer type tendency, the study intends to investigate some geographic analysis processes (table 2) to introduce the GIS as an important supporting tool for the
development planning of States and Municipalities of other developing countries like Brazil in the social, economic and cultural areas, providing quickness and reliability of execution, control and evaluation of administrative politics, especially in public health.

Table 2: Processes of geographic analysis.

<table>
<thead>
<tr>
<th>Analyse</th>
<th>General question</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition</td>
<td>What is/are ...?</td>
<td>What are the socio-environmental conditions of the population most affected by lung cancer?</td>
</tr>
<tr>
<td>Location</td>
<td>Where is...?</td>
<td>Which are the geographical areas with major cancer incidence?</td>
</tr>
<tr>
<td>Patterns</td>
<td>What is the pattern...?</td>
<td>How is lung cancer incidence distributed in the State of Santa Catarina?</td>
</tr>
<tr>
<td>Models</td>
<td>What happens...?</td>
<td>How do coal mining rejects impact the health of people exposed to them?</td>
</tr>
</tbody>
</table>

ACKNOWLEDGEMENT

To Irmandade do Senhor Jesus dos Passos (the Charity Hospital of Florianópolis/SC) for useful explanations and data on cancer occurrences; to Intergraph – the Team Geomedia Group, for making the Software Geomedia Professional 5.1 available to the research team; to the staff of the Geoprocessing Laboratory (GeoLab) of the Federal University of Santa Catarina Geography Course, for the invaluable commentaries and technological support.

REFERENCES


